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PROPOSAL FOR DEVELOPMENT OF CUTTING TECHNOLOGY FOR EVAPORITE MINING

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MICROMEDIA

PROPOSAL FOR STUDIES ON CUTTING TECHNOLOGY FOR EVAPORITE MINING
Part 1 – REVIEW OF MINING COMPANY IN-HOUSE RESEARCH

G. Knight*

ABSTRACT

Some mining companies have carried out research and tests on cutting technology. It is proposed to gather these studies together to form a CANMET report for ready reference.

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KEYWORDS: Evaporite Mining, Dust Control, Cutting Parameters, Research Proposal

PROPOSITION D'ÉTUDES SUR LA TECHNOLOGIE DU HAVAGE DE L'ÉVAPORITE
Partie 1 – REVUE DES RECHERCHES INTERNES DE L'INDUSTRIE MINIÈRE

G. Knight*

RÉSUMÉ

Certaines sociétés minières ont effectué de la recherche et des essais en matière de technologie du havage. On propose de réunir ces études dans un rapport de CANMET qui serait immédiatement disponible pour la consultation.

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MOTS CLES: exploitation de l'évaporite, depoussiérage,
paramètres de havage, proposition de recherche

BACKGROUND

Airborne dust, cutting technology and energy inputs are major considerations in the application of cutting machines to extract evaporite ores. Many concerned with coal and rock cutting have found correlations between the amounts of fine potentially airborne dust produced and the cutting parameters. Some also found that there was a correlation between dust generation and energy input. The important cutting parameters are: tool size, shape and material; depth of cut, lacing pattern and speed; and the position and quantity of water application.

Major advances have been made in reducing specific dust generation and energy input in coal mining using cutting techniques by research into and development of cutting technology. A range of 1000 to 1 has been measured in specific airborne dust dispersion, in weight of dust per ton of coal cut. It should be noted that a major factor in achieving acceptable dust conditions in coal faces with a productivity as high as a 1000 tonnes per shift has been the reduction in dust generation achieved by the improved cutting technology. The use of water in coal cutting technology is responsible for dust reductions of the order of one tenth.

The advances in coal cutting cannot be applied directly to evaporite cutting because of the different rock parameters and because of the very much lower tolerance to water usage for dust control and cutting enhancement.

Two major forms of rock cutting action are described as indentation and wedge or cleavage . In indentation, such as roller cutters, the normal force predominates whereas in wedge cutting with a sharp bit the cutting or parallel force predominates. In both cases a compressive force is applied to the rock through the cutting tool causing a crushed region and a tensile force in the surrounding region leading to crack propagation and chip formation. In general the bigger the chips the lower is the specific energy required and the amount of primary fine dust produced. Wedge cutters have been used almost entirely in coal and evaporite mines. Roller cutters are usually required in much harder rocks.

The mechanisms involved in production of fine dust and its dispersion into the air are:

1. Primary dust is that produced directly by the tool during cutting and can be considered in parts as follows:

    (a) Produced in the crushed zone adjacent to the pick

    (b) Produced by breakage in the propagating crack induced by tensile failure

(c) Dust already present as in slip planes

2. Secondary dust is that produced when the broken rock is broken further by being trapped between moving and stationary parts of the machine or rock prior to loading and transport.
3. Direct dispersion during breakage. Strain energy is released at breakage, some of this is transferred to kinetic energy of the breakage fragments and they can be projected into the airstream.
4. Tumbling and windmilling of the broken rock and machine components can disperse some of the already formed fine dust into the air.

Local airflows play a very important part in the dispersion of dust. The main airflow is effective in diluting the dispersed dust to tolerable levels. In coal mines a substantial airflow is usually required to dilute methane gas and reduce the possibility of ignitions. However, in evaporite mines, there is a much lower possibility of gas emissions and the reduction of dust dispersion by control of local airflows could give substantial advantages in reducing the main airflow and its cost. Such methods as shrouding or cowls are available.

Cutting parameters,particularly depth of cut, have been shown to affect both dust production and energy consumption to a very large extent. Both have been reduced by factors of one thousand or more since the first introduction of coal cutters and there seems to be considerable room for improvement in the cutting techniques being used in evaporite mines.

Water has been shown to give substantial advantages in rock cutting such as: increases in crack propagation; clearing chips from the cutting zone and reducing energy input and dust formation; reducing pick forces during cutting; cooling the pick and lastly reducing dust dispersion into the air by binding fine potentially-airborne dust particles to coarser non-dispersible fragments (13). Water has had limited use in evaporite mines for dust control but not apparently for maximum improvement in cutting (14,15).

It is also possible that the presence of water improves the transmission of stress from the tool to the rock and reduces the amount of crushing occuring before and during crack propagation to form a chip.The concensus of opinion is that water should be fed to the pick as close as possible to the cutting face of the tool.

It is clear that the use of water in cutting has great advantages in both cutting and in dust control. However, there is a major possible problem in using water in evaporite mines as it might lead to a breakdown in the transport system by fusing lumps of the soluble ore together and by increasing corrosion. It seems to be absolutely necessary that any usage of water in the evaporite mines would have to be very carefully controlled (15,19). Possibly the

amount that could be applied to the ore should not exceed that lost by evaporation during transport on the conveyor belts etc.. It would seem desirable to carry out preliminary wetting experiments at a site where excess water would not cause a major problem.

The evaporation of dust control water might not nullify the effect because the fine potentially airborne dust particles could have fused to the coarser fragments and thus not be available for subsequent dispersion as at transfer points.

The proposed research is expected to improve the performance of evaporite mining machines and dust control.

RESEARCH OBJECTIVES

The specific objectives of the cutting in evaporite mining studies are:

1. Reduction in airborne dust
2. Reduction in energy consumption
3. Reduction in other costs
4. Increase in productivity

The studies are likely to lead to a change in particle size distribution of the output with fewer fines and more coarse breakage fragments. This change is expected to improve ore handling characteristics in storage bunkers and chutes as well as to reduce the ore losses in transport. This amounts to about 5% of the total production.

The objective of the first stage is to gather together the studies carried out in canadian evaporite mines and make them available for application throughout the mining and machine manufacturing industry and as a basis for the design of further research.

TECHNICAL APPROACH

Some canadian mines have already built an in-seam tester following the US approach for coal mines. This work has not been published and , with the cost cutting in the industry, the sections who were active have been partially disbanded. The information gathered is possibly being lost. It is suggested that a contract should be issued to gather the available studies and publish them as a CANMET contract report. The suggested form of the report is an executive summary together with verbatim reproductions of the mine in-house reports.

ANTICIPATED BENEFITS

1. A substantial reduction in specific production of fine potentially-airborne dust can be expected resulting in lesser dust problems at the cutter and throughout the transport system.
2. A decrease in the specific energy consumption in cutting.
3. A decrease in specific auxiliary costs.

ESTIMATED COSTS: part 1

1. Capital Equipment	$ 0
2. Supplies	2 000
3. Personnel—It is estimated the project will have a two month duration	
a. Project Engineer–part time at $40 000/year	4 000
The total cost of this project is estimated to be	$ 6 000

WORK PLAN

Part 1 of the project will take two months to complete. The advice received is that Paul Labbé of Domtar Hamilton is the most suitable person for this review. Domtar is interested in the ongoing application of improved cutting techniques and dust control. PCS has been his past employer and was where he and his colleagues carried out a lot of the studies. The review should also cover the ancillary studies such as measurement of size distribution of cut material and degradation in transport to the surface.

CASH FLOW ESTIMATES

The total expenditure of $ 6000 is to be spent in the two month period.

TECHNOLOGY TRANSFER

The results will be useful in planning further studies and for application to the canadian evaporite mining industry.